

TABLE 3.—Free-air resultant winds (meters per second) based on pilot-balloon observations made near 7 a. m. (E. S. T.) during July, 1930—Continued

Altitude (meters) m. s. l.	Medford, Oreg. (410 meters)		Memphis, Tenn. (145 meters)		New Orleans, La. (25 meters)		Omaha, Nebr. La. (321 meters)		Royal Center, Ind. (225 meters)		Salt Lake City, Utah (1,294 meters)		San Francisco, Calif. (8 meters)		Sault Ste. Marie, Mich. (198 meters)		Seattle, Wash. (14 meters)		Washington, D. C. (10 meters)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
Surface.....	°		°		°		°		°		°		°		°		°		°	
500.....	S 24 W	0.4	S 36 W	0.9	N 67 W	0.6	S 23 E	0.9	S 8 E	0.8	S 26 E	3.3	N 33 E	0.1	N 60 W	0.7	S 19 E	0.3	N 86 W	0.4
1,000.....	S 72 W	0.9	N 81 W	3.2	N 70 W	4.2	S 26 W	4.6	S 63 W	3.2	S 7 W	2.3	S 7 W	2.3	N 56 W	3.2	S 5 W	0.7	N 82 W	4.2
1,500.....	N 61 W	1.5	N 72 W	4.1	N 64 W	2.8	S 62 W	8.6	N 72 W	5.4	N 31 W	1.7	N 62 W	4.6	N 7 W	0.3	N 7 W	0.3	N 56 W	6.5
2,000.....	N 61 W	0.8	N 61 W	4.1	N 6 W	0.6	S 75 W	6.7	N 56 W	5.7	S 20 E	5.7	N 47 E	0.7	N 62 W	7.6	N 25 W	1.0	N 58 W	6.6
2,500.....	N 73 E	0.4	N 63 W	3.4	N 84 E	1.1	S 84 W	5.5	N 60 W	7.5	S 2 W	5.4	S 87 E	1.0	N 62 W	8.9	S 2 E	0.9	N 60 W	7.9
3,000.....	S 31 W	3.5	N 62 W	2.4	S 69 E	2.1	S 89 W	4.4	N 51 W	8.7	S 22 W	3.1			N 60 W	10.0	S 29 W	2.4	N 69 W	8.0
3,500.....	S 30 W	5.5	N 74 W	1.8	S 74 E	2.5	S 87 W	4.8	N 53 W	9.7	S 48 W	3.0			N 57 W	10.6	S 33 W	2.9	N 64 W	8.5
4,000.....	S 36 W	7.9	N 58 W	3.0	S 70 E	2.8	N 75 W	6.2	N 53 W	11.5	S 42 W	3.9			N 53 W	12.0	S 49 W	5.1	N 65 W	9.7
5,000.....			N 56 W	3.5	N 78 E	3.4	N 76 W	7.4	N 54 W	9.7	S 33 W	4.1			N 47 W	13.6	S 47 W	8.5		

TABLE 4.—Observations by means of kites, captive and limited-height sounding balloons during July, 1930

	Broken Arrow, Okla.	Due West, S. C.	Ellen- dale, N. Dak.	Groes- beck, Tex.	Royal Center, Ind.
Mean altitudes (meters), m. s. l., reached during month.....	3,058	2,592	3,074	2,226	3,347
Maximum altitude (meters), m. s. l., reached and date.....	16,397	14,585	14,939	14,029	17,171
Number of flights made.....	31	29	32	25	28
Number of days on which flights were made.....	30	29	29	25	27

1 30th. 1 11th. 1 25th. 1 23rd. 1 3d.

In addition to the above there were approximately 125 pilot balloon observations made daily at 53 Weather Bureau stations in the United States.

WEATHER IN THE UNITED STATES

THE WEATHER ELEMENTS

By H. C. HUNTER

GENERAL SUMMARY

July was one of the hottest months in the history of the Weather Bureau, also one of the driest summer months. Only small portions of the country had either more rain or lower average temperature than the mean of other Julys. The dryness was intense mainly in those east-central and south-central districts which were sorely in need of moisture when the month began, but other districts, especially to northward and westward, received very little rainfall in July. The heat was felt widely for considerable periods of time, and high marks occurred at great numbers of stations. In the Missouri Valley every first-order station recorded 100° or higher; in the upper Mississippi Valley, 9 out of 15; in the Ohio Valley and Tennessee, 14 out of 16; in the east Gulf area, 9 out of 12; and in the Middle Atlantic States, 11 out of 18.

TEMPERATURE

The first half was mainly warmer than normal, save in the Lake region and the Northeastern States and in portions of the Southwest. Unusual heat prevailed in the Plains and the northern Rocky Mountain region, also after the 5th in the central valleys and most of the Southeast.

The final half was a period of record-breaking heat in many northern and middle portions east of the Rocky Mountains, but in the southern portion and the far West the temperatures usually averaged about normal.

For July as a whole the temperature averaged above normal in nearly all sections, only five States of the far

West, in addition to New York and New England, finding the month of but normal temperature or slightly lower. Generally from the interior portions of the Middle and East Gulf States northwestward to the middle and northern Plains the month averaged 4° to 7° hotter than normal. It was among the hottest ever recorded from the northern and middle Plains southeastward to the southern Middle Atlantic States and the South Atlantic and East Gulf States, though stations close to the seacoast usually found it from 1° to 4° less hot than the hottest month of previous record.

At Little Rock, Ark., the month was 1.4° hotter than any previous month in a 50-year record; at Tampa, Fla., the month was 0.5° hotter than any previous July in a 40-year record, though failing to equal August, 1924; at Chattanooga, Tenn., the month was warmer than any August or any previous July in a record of 51 years, though not quite so hot as September, 1925; and at Atlantic City, N. J., the month was exceeded by but two previous months in a record of 56 years. At Washington, D. C., the month was the hottest in almost 60 years, save July, 1872, which slightly exceeded it, and Julys of 1876 and 1887, which practically equaled it. Numerous places with records for 20 to 40 years found no other month so hot.

From Pennsylvania northeastward and in the Lake region the July average was not extraordinary, and this was the case over much of the Southwest and the far West, save near the southern California coast.

Remarkably high temperatures were experienced during several periods of the month. The highest marks in portions of the northern Plains and in much of the Southeast occurred about the 12th. In the southern portion of the Lake region, the Middle Atlantic States and much of the Ohio Valley the top marks were noted about the

20th. The last week of July brought the highest readings to most of the middle Plains and the central valleys.

About 10 stations, with records exceeding 50 years, attained new high temperature records during the month, and a large number of places with shorter records.

Passing to sections where the temperatures were not so noteworthy, it is found that the Northeast and the northern portion of the Lake region scored their highest marks of the month about the 19th to 21st, but the far Western States on various dates.

The lowest readings of July occurred early in the month at very many stations, particularly in the Southwest and the Southeast, but about the 14th to 17th at most places from the middle and northern Plains eastward to the Atlantic coast.

PRECIPITATION

The rainfall was poorly distributed over the country, and such amounts as did fall were not well distributed through the month. The country as a whole has seldom received less rain in a summer month.

The first half of the month usually was not marked by so scanty rainfall as the second half, and of the first half the opening week was generally the time of more plentiful rains. However, the latter half brought as much rain as the first half, or even more, to some portions of the Plains and the far Southwest, and notably to most of the East Gulf and South Atlantic States. From Alabama and northern Florida to South Carolina there usually were liberal rains about the 17th, and again during the period from the 23d to the 29th.

The aggregate July rainfall was less than normal in all sections of the country except some small areas along the Atlantic coast or in the Lake region, and from Wyoming and southeastern Idaho southward to the central parts of Arizona and New Mexico. Portions of this last-named region received more than twice as much rain as the average quantities of previous July records.

In the many regions where the rainfall was less than normal, several stand out as having but a small percentage of the normal. Of the east-central, central, south-central, and southwestern sections large portions measured only from 25 to 50 per cent of the normal, while a number of areas in the central and lower Mississippi Valley and the Red River Valley received less than 5 per cent. Practically all of the Pacific States received no precipitation at all during the month, but a great part of this area normally is without rain in July.

Considering those districts which had entered July with severe need of rains, it is found that the scarcity of rainfall during July was very marked over the Ohio and the middle and lower Mississippi Valleys, also over much of eastern and north-central Texas and most of the Dakotas and western Minnesota. Likewise the interior area of the Middle Atlantic States from central Pennsylvania southward continued exceedingly dry.

Marked shortages occurred in July in many districts which came to the end of June with moderate or ample

soil moisture, namely—southern Michigan and adjacent portions of Ohio and Indiana, practically all parts of Missouri, Illinois, Iowa, and Minnesota which had fared well before July, western and northern Wisconsin, and the central plains.

Over a considerable portion of the drought-stricken area there had been scanty precipitation during all months or almost all since 1930 began, or even from the late months of 1929. This had resulted in deficient supplies of ground water and in scanty stream flow.

The most severe drought conditions in the normally wetter part of the country were to be found in a very large portion of the Ohio River drainage area and in most of the area within 150 miles of the lower course of the Mississippi River. Here both June and July failed to bring as much as half of the normal rainfall; and in large portions of the areas specified the situation was considerably worse than even this implies. Less than one-third of the combined normal amount for June and July was received in southern Illinois, southeastern Missouri, western Tennessee, northeastern, central, and southern Arkansas, northern and central Mississippi, northern and southwestern Louisiana, and much of eastern Texas.

Among well-known stations of the afflicted area, these cases are cited: Cairo, Ill., received in June and July together but 1.63 inches; Memphis, Tenn., 0.33 inch; Little Rock, Ark., 0.13 inch; Vicksburg, Miss., 0.71 inch; Shreveport, La., 0.97 inch; and Galveston, Tex., 0.32 inch.

SUNSHINE AND RELATIVE HUMIDITY

The month brought considerably more clear weather than usual over a great portion of the country. The amount of sunshine was particularly large in the Ohio and Mississippi Valleys and the Plains States, but was somewhat greater than usual in July in substantially all of the Atlantic States.

The relative humidity, as generally happens, was deficient in most States where the sunshine was more than usual, so that nearly the entire country showed a lower percentage of humidity than the average of previous Julys. From the upper Ohio Valley and the southern Appalachian region westward and northwestward to the western plains the deficiency was 15 per cent or more and in parts of the central valleys and the Ozark region the deficiencies were more than 20 per cent.

The month showed somewhat greater relative humidity than normal over most of the southern Rocky Mountain and Plateau regions, and likewise in northeastern New York and northern New England.

The remarkably low humidity in the area where temperatures were so high made the situation worse for crops than it would otherwise have been; and the loss of moisture severely affected crops in all but the very few small areas where substantial showers occurred to provide new supplies of moisture to plants. However, for men and animals the low humidity made the suffering from heat less intense.